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ABSTRACT

A study investigated suggested interrelationships of linguistic awareness, cognitive ability, and reading achievement. The extent to which differences in reading achievement were related to differences in the other areas was also explored. The Linguistic Awareness in Reading Test (LARR), the Coloured Progressive Matrices (CPM), and the Stanford Achievement Test (SAT), Primary Level I, Total Reading, were administered to 98 first grade students. Interrelationships among the measures of linguistic awareness, nonverbal problem-solving ability, and reading achievement for the sample were analyzed using correlation techniques. To assess whether differences in reading achievement were related to performance on the other two measures, subjects were assigned to rating groups determined by stanine intervals. SAT reading ratings were employed in a series of one way ANOVA of LARR and CPM scores. The results indicated significant differences between each of the three SAT reading groups. The group rated high on SAT performed better on the CPM than the average group, who performed better than the low SAT group. In addition, students rated high in reading achievement scored better on the LARR than students rated average, who in turn outscored students rated low in reading achievement. The findings involving concurrent interrelationships among LARR, CPM, and SAT reading performance suggest that thought be given to designing a prereading or beginning reading curriculum that not only makes apparent the speech-print connection but also recognizes learning to read as an active, problem-solving endeavor. (HTH)

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Solving the Problem of Learning to Read:

Children's Linguistic Awareness and Reading Progress

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CS 007 247

Running Head: Solving the Problem of Learning to Read

Solving the Problem of Learning to Read: Children's Linguistic Awareness and Reading Progress

Downing (1972, 1979) has proposed the Cognitive Clarity Theory of learning to read in response to an accumulation of evidence implicating "linguistic awareness" (i.e., understanding of the functions and features of language as an important correlate of reading acquisition (for a review of this research, see Ehri, 1979). As reported in the literature, readers, in contrast to nonreaders or unskilled readers, are in general, better able to identify linguistic elements (e.g., phonemes, syllables, words) in speech and in writing, use acoustic length of a word as a clue to its orthographic correspondent, and recognize the communicative purpose of reading (e.g., Downing & Oliver, 1973-1974; Ehri, 1975; Evans, Taylor & Blum, 1979; Hiebert, 1981; Johns, 1980; Lee, 1980; Morais, Cary, Alegria, & Bertelson, 1979; Rozin, Bressman, & Taft, 1974; Ryan, McNamara, & Kenney, 1977; Zifcak, 1981). The central premise of Downing's theory is that "learning to read is essentially a problem-solving task in which the child applies reasoning abilities to understanding the linguistic relationships between speech and writing" (Downing, 1979, p. 10). Although findings of a number of studies demonstrate that children's reading achievement has a significant correlation with their intellectual capacity, evidence supportive of the interrelation of linguistic concepts problem-solving ability,

and reading skill as posited by Downing is limited.

Background

Correlations between measures of intelligence and reading achievement range from .20 to .84 (Chall, 1967; Downing & Thackray, 1972). Because performance on intelligence tests may be increasingly affected by school learning (Lennon, 1964), Robeck and Wilson (1974) contend that the most accurate estimate of the correlation between reading achievement and intellectual ability should be obtained at the beginning of formal schooling or by use of a nonverbal measure of intelligence. When such a strategy is employed, the correlation found appears nominal (approximate r = .25) (Robeck & Wilson, 1974).

Others have shifted the focus from cognitive ability as measured by a standard intelligence test to cognitive developmental facors described in Piagetian theory. Waller (1977) argues that the child's mastery of symbolic representation during the preoperational period prepares the way for learning to read. In his view, the child must understand the symbolic aspect of print in order for reading to be acquired. Research by Briggs and Elkind (1973) indicates that an "operativity" factor associated with successful performance on Piagetian tasks is significantly correlated with early reading among 5-year-olds.

In examining interrelationships among cognitive ability, linguistic awareness, and reading, both standard and Piagetian measures of cognitive performance have been used. By controlling for the effect of children's vocabulary scores on the

Stanford-Binet Scale, Francis (1973) found a significant partial correlation between children's linguistic concepts and reading progress (partial Kendall $\underline{r}$ = .34). Because this finding suggested that the relationship between children's linguistic concepts and their reading achievement existed independent of intellectual ability, Francis inferred that "difficulty in comprehending the technical vocabulary of reading . . . appears to be an integral part of the difficulty in learning to read, rather than a separate conceptual difficulty" (p. 23).

Jewell (1978) found that conservation ability as measured by the Piagetian-based Concept Assessment Kit administered in kindergarten did not predict first grade reading achievement. However, a significant correlation was found between scores on a test of linguistic awareness and conservation scores, indicating that both tests tapped a common factor. Hiebert (1980) employed a variety of measures in order to discover relationships of preschoolers' logical reasoning ability, oral language comprehension, and home experiences to their print awareness. Results indicated that logical reasoning was the single best predictor of performance on measures of print awareness ($\underline{r}$ = .47 - .56). An operational level of reasoning did not appear necessary for acquisition of print concepts; rather, more global factors appeared to be involved. Multivariate analysis revealed that up to 56 percent of variance on print awareness measures was accounted for by logical reasoning, language comprehension, and home experiences. Hiebert concluded that "linguistic and cognitive factors seem to be

inextricably interwoven in young children's development of print awareness" (p. 321).

These findings offer support for Downing's theoretical position. The purpose of the present study was to investigate further the suggested interrelationships of linguistic awareness cognitive ability and reading achievement. In addition, the extent to which differences in reading achievement were related to differences in the other areas was also explored.

For these purposes the use of a test of general nonverbal problem-solving ability was deemed more consistent with the Cognitive Clarity Theory than previously tried approaches.

Method

Subjects

The population sampled were first grade students attending public schools in Murfreesboro, Tennessee which is located 30 miles from Nashville. Because of the diversity of its economy, including industry, retail trade, and agriculture, in addition to the presence of a state university, this community of 33,000 is heterogeneous with respect to its population characteristics.

First graders in four of the five Murfreesboro schools were invited to participate in the study (first graders in the fifth school were involved in a pilot study). All volunteers had to meet the following criteria: a) were not first grade retainees, b) dominant language spoken in the home was English, and c) did not have an identified hearing problem. The sample thus selected consisted of 98 students, 43 males and 55 females.

The mean age of the sample was 7.1 years.

Measures

On the basis of the Cognitive Clarity Theory, Ayers, Downing and Schaefer (1977) have devised the Linguistic Awareness in Reading Readiness Test (LARR). Investigations of the reliability and the validity of the LARR have resulted in consistent improvement and refinement of the instrument (Downing & Ayers, in press; Downing, 1972; Downing & Oliver, 1973-1974; Downing, Ollila, & Oliver, 1975, 1977; Evanechko, Ollila, Downing & Braun, 1973). A recent study of 290 kindergarten children by Downing and Ayers estimated the reliability of the two forms of LARR as .86 to .93. In the same study, the LARR demonstrated substantial predictive validity for first grade reading achievement of the sample on the Cooperative Primary Reading Test, Form 12A.

The Coloured Progressive Matrices (CPM) (Raven, 1962), a test of the intellectual capacity to make comparisons and to reason by analogy, was used to assess nonverbal problem-solving ability. Performance on the CPM is substantially correlated to performance on other well-known intelligence tests including the Stanford-Binet Intelligence Scale and Wechsler Intelligence Scale for Children (Burke, 1958; Ramsey & Wright, 1968). A study by Matthews (1976) indicated a substantial relationship between CPM score and conservation ability as measured by the Concept Assessment Kit. Factor analysis revealed that the CPM taps a combination of spatial and reasoning abilities (Kirby & Das, 1978). Hall and Kaye (1977) found that

among 31 measures of memory, learning, and transfer, the CPM was one of the most efficient predictors of the reading and math achievement for 600 males, ages 6 to 8 years old. Although the reliability and validity of scores limit its value in decision-making, the CPM is appropriate as a screening test, in ascertaining the intellectual level of groups of children, in clinical work, and as a research tool (Burke, 1958). According to Robeck and Wilson (1974), "the absence of verbal requirements and the loading on perceptual accuracy make this test useful in working with pupils who experience reading difficulties" (p. 346).

The Stanford Achievement Test, Primary Level I, Total Reading (SAT Reading) (Madden, Gardner, Rudman, Karlsen, & Merwin, 1973) was employed as the measure of reading achievement in this study. SAT Reading is composed of the Reading and Word Study Skills subtests. These subtests tap a broad range of reading skills including: comprehension, word attack and phonics skills.

Procedure

The testing program began in mid-April, 1981, immediately following the administration of the SAT to all Murfreesboro students by their classroom teachers. The testing program lasted one month.

The LARR and CPM were administered by the investigator and a trained assistant. The LARR was given to groups of no more than 10 students. LARR testing usually required 45 minutes. The CPM was administered individually to students. After the

testing program was completed, SAT scores and descriptive data for each subject were collected from school records.

Interrelationships among the measures of linguistic awareness, nonverbal problem-solving ability, and reading achievement for the sample were analyzed using correlation, multiple correlation, and partial correlation techniques. In order to assess whether differences in reading achievement by the sample was related to performance on the other two measures, subjects were assigned to rating groups (i.e., High, Average, Low) based on their SAT Reading stanine score. Ratings were determined by the following stanine intervals: stanine 7-9 (High); stanine 4-6 (Average); stanine 1-3 (Low). SAT Reading ratings were employed in a series of one way analysis of variance (ANOVA) of scores achieved by subjects on the LARR and CPM. Following sginificant findings (at least $p > .05$) with ANOVA procedure, Newman-Keuls Analysis was used to determine between which groups significant differences existed.

Results

Mean raw scores and standard deviations for LARR, CPM, and SAT Reading achieved by the sample are presented in Table 1. However, all analyses involving the CPM made use of percentile scores. Mean percentile score on the CPM was 55.35. A comparison was made of the mean SAT Reading score of the Murfreesboro sample and that of the SAT norming sample (beginning of second grade: $\bar{107.3}$; $SD = 30.05$) (Madden, et al., 1973). Results revealed that there was no significant difference in the mean scores of the two groups ($z = 1.74$).

Insert Table 1 about here

Before proceeding to analysis, all data were checked by means of scatter plots. Because there was no evidence of other than linear relations among scores, Pearson product-moment correlations were calculated. Table 2 presents intercorrelations among LARR, CPM, and SAT Reading scores. All correlations were significant ($p > .01$).

Insert Table 2 about here

SAT Reading performance was used as the criterion variable for the calculation of a multiple correlation with LARR performance and CPM performance as predictors. The obtained multiple R of .73 was significant ($p > .01$). An R^2 of .54 indicated that 54% of the variance in SAT Reading performance was accounted for by the variance in combined LARR and CPM performance. Beta weights were as follows: .5068 (LARR), and .3178 (CPM).

These significant findings prompted additional data analysis. A partial correlation was computed between SAT Reading and LARR performance with the effect of CPM performance removed. The obtained partial correlation of .53 was significant (t [95] = 6.03, $p > .001$). Thus there appeared to be a substantial relationship between SAT Reading and LARR scores regardless of CPM score.

The differences in LARR scores of first graders rated low, average, and high on their SAT Reading performance were also

examined. Categorized on the basis of SAT Reading ratings, number of subjects in each group were as follows: 13 (Low), 43 (Average), and 42 (High). Hartley's test was employed to test the assumption of equal cell variances. The degree of heterogeneity was nonsignificant (F_{max} [12/41] = 2.71 $p > .01$). One-way analysis of variance revealed significant differences in LARR scores among the SAT Reading rating groups. The findings of the analysis of variance are reported in Table 3.

Insert Table 3 about here

Newman-Keuls Analysis was utilized to determine the means between which significant differences were present. The Newman-Keuls analysis indicated that the differences in mean LARR scores between each SAT Reading rating group were significant. The group of first graders rated high in SAT Reading performance scored higher on the LARR than the average group, who in turn scored higher than the group of first graders rated low in SAT Reading.

Differences in CPM scores of first graders rated low, average, and high in their SAT Reading rating. Results of Hartley's test suggested that the degree of heterogeneity among cell variances was nonsignificant (F_{max} [42/12] = 1.27, $p > .05$). A one-way analysis of variance indicated significant differences in CPM scores of first graders rated low, average, and high on SAT Reading performance. Table 4 presents the results of the analysis of variance.

Insert Table 4 about here

Newman-Keuls Analysis was employed to locate the SAT Reading rating group(s) between which significant differences in CPM mean score existed. Significant differences emerged between each of the three SAT Reading rating groups: the group of students rated high on SAT Reading performed better on the CPM than the average group, who performed better than the low SAT Reading rating group.

Discussion

Consistent with findings by Downing and Ayers (in press), Evans et al. (1979), Johns (1980), and others, results of this study reveal a significant relationship between performance on a measure of linguistic awareness and on a measure of reading achievement. In addition, significant differences in LARR performance materialized among students at three levels of tested reading achievement--students rated high in reading achievement scored better on the LARR than students rated average, who in turn outscored students rated low in reading achievement. This finding parallels Johns' results utilizing different instruments measuring similar abilities. The relationship between LARR performance and first grade reading progress lends further corroboration to the validity of the LARR instrument. The concurrent correlation found (r = .68) is comparable to the predicative correlations between kindergarten LARR performance and tested first grade reading achievement reported by Downing and Ayers.

Results further suggest that nonverbal problem-solving

ability, as measured by the CPM, is significantly related to both LARR performance and SAT Reading performance of the sample. In addition, when students were grouped according to their reading achievement, students rated high on SAT Reading scored better on the CPM than students rated average, who in turn outscored students rated low on SAT Reading. Moreover, a substantial multiple association between LARR and CPM performance as the criterion, demonstrated that each measure made a unique contribution in the prediction of reading achievement. These findings provide support for Downing's Cognitive Clarity Theory of learning to read. According to this theory, linguistic awareness is the outcome of successful problem-solving about the relationship of speech and print. Although causality cannot be inferred, the evidence does indicate important interrelationships among performances on measures of linguistic awareness, nonverbal problem-solving ability, and reading achievement.

When SAT Reading performance and CPM performance were combined to yield a multiple correlation with LARR performance as the criterion, a greater contribution was made by SAT Reading performance than by CPM performance. Analysis of the data also revealed that the relationship between linguistic awareness scores and reading achievement continued to be significant when the effect of CPM scores were removed (partial r = .53). This finding suggested that the LARR assessed other factors related to SAT Reading performance but not associated with CPM performance. Based on these results, this investigator concurs with Francis (1973) that the development of linguistic concepts

appears more related to reading progress than to general cognitive ability.

Perhaps the most intriguing finding of this investigation has not been reported thus far due to the small number of subjects involved. In preparing data for analyses, LARR scores were grouped by SAT Reading rating and by CPM rating. As would be expected, the group of students rated low on both SAT Reading and on the CPM (N = 8) had the lowest mean score on the LARR ($38.\overline{50}$) relative to the other groups, while the group of students scoring average or better on both measures (N = 78) had the highest mean score ($56.\overline{55}$). However, the group of students who scored low on SAT Reading but average or better on the CPM (N = 7) had a nearly identical mean score on the LARR with the group of students who scored average or better on the SAT but low on the CPM (N = 5) ($46.\overline{40}$, $46.\overline{43}$ respectively, $\underline{t}$ [10] = .006). This unexpected finding offers a possible explanation as to why some researchers (Blum, Taylor, & Blum, 1979; Chapparro, 1977) have encountered problems in using linguistic concept measures with older students. Their results indicated that performance on certain of these measures does not always distinguish better readers from poorer readers. It is hypothesized, pending further research, that adequate nonverbal problem-solving ability as measured by the CPM compensates for low reading skill, allowing more successful responses to linguistic awareness problems. Thus nonverbal problem-solving ability may have a pivotal relationship with linguistic awareness ability.

The instructional significance of findings involving

concurrent interrelationships among LARR, CPM, and SAT Reading performance suggests that thought be given to designing a pre-reading or beginning reading curriculum that not only makes apparent the speech-print connection but also recognizes learning to read as an active, problem-solving endeavor. In this regard, the specific curriculum proposals of Downing (1979) based on the Cognitive Clarity Theory of learning to read merit consideration as an area of research.

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